Development and Validation of a Tool for Analysis of Hockey Related Head Impacts Captured on Video

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Background

- Ice hockey has one of the highest concussion incidences amongst contact sports globally, with professional athletes experiencing an average of 6.5 concussions per 1000 player game hours\(^1\).
- Despite these advances in documenting the mechanism of concussion rates of concussion have yet to significantly decrease in ice hockey.

Thus, the purpose of this project was to develop and test the inter-rater reliability of a 44-item tool that examines, based on video footage, the biomechanical, situational, and environmental aspects of head impacts occurring at the professional level of ice hockey.

Methods

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<td>The Heads-Up Checklist(^2)</td>
<td>Concussive event, game situation and game sheet</td>
<td>199 concussive events</td>
<td>Many concussive hits are initiated with opposing player’s upper limb</td>
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<td>The Carolina Hockey Evaluation of Children’s Checking(^3)</td>
<td>Player’s body positioning and anticipation of the hit</td>
<td>666 body collisions</td>
<td>Anticipated hits resulted in less severe head impacts</td>
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Figure 1. The fast speeds of ice hockey make it difficult to accurately detail the mechanism of concussion however two previous studies have addressed this issue through the use of video footage.

- Figure 2. When used to analyze a hit, 32 questions from all five parts of the I-HIT are answered by two randomly assigned, trained research assistants. For each question their confidence level in the answer being correct is described between 0-100%. Eight questions from the I-HIT are adapted from Hutchison’s tool and eight are adapted from Mihalik’s tool.

- Figure 3. Thirty videos of NHL level head impacts were randomly selected from two sources: YouTube (n=12) and the Department of Player Safety’s website (n=18). All hits occurred during the 2011-2012 through 2014-2015 seasons.

- Figure 4. To determine the inter-rater reliability for each question we calculated the Total Percent Agreement (n=32), Cohen’s Kappa (n=30) and the Prevalence and Bias Adjusted Kappa (n=9). The figure explains the recommendations we followed for interpretation of the Kappa values\(^4\).

Reliability Results

- Figure 5. Of the 32 questions a TPA value was calculated for, all of them had a TPA greater than 70% (mean = 85%, SD = 10%).

- Figure 6. Of the 30 questions a Kappa value was calculated for, 21 of them produced either almost perfect or substantial agreement (mean = 0.71, SD = 0.15). Average confidence per question in the answer being correct ranged from 81 to 98%.

Emerging Trends

- The striking object making contact with the player’s head was the opposing player’s upper limb 70% of the time with 43% of those cases being the shoulder.
- In only 30% of cases did the player initiate an anticipatory strategy. Of these cases, the most commonly used strategy involved raising the arms in front of the body to lessen the incoming impact.

Discussion

- The I-HIT was able to reliably assess the biomechanical, situational and environmental aspects of head impacts in ice hockey by combining important elements from published tools and introducing novel elements such as direction of contact force to head and anticipatory strategy implemented.

Moving forward, in partnership with the SFU Men’s Ice Hockey Team, collection of head impact data is ongoing. The I-HIT is now being used to analyze video footage of these collegiate level head impacts and in conjunction with in-helmet sensor data we hope to be able to better conclude which type of hits result in more severe head accelerations.

References & Acknowledgements